Effects of Crew Coordination Training and Evaluation Methods on AH-64 Attack Helicopter Battalion Crew Performance

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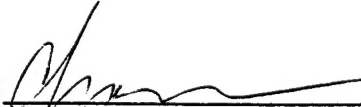
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Introduction

Dynamics Research Corporation (DRC), under contract to the US Army Research Institute Aviation Research & Development Activity (USARIARDA), developed, evaluated, and validated an exportable Army Crew Coordination training and evaluation package. The development of the training and evaluation systems and the results of the US Army Aviation Center (USAAVNC) sponsored crew coordination validation testbed conducted by air assault battalion crews are in companion reports delivered to USARIARDA (Pawlik et al., 1993; Grubb et al., 1993; and Simon et al., 1993). The following report describes the most recent phase of this research, orchestrated by the USARIARDA and USAAVNC and technically supported by DRC. This report focuses on the results of providing attack helicopter battalion crews with crew coordination training in preparation for follow-on research to assess the interaction of battle rostering and crew coordination training.

Background

Over the last several years, USARIARDA has been conducting a program of training research that responds to the Army's need for better crew coordination training. This program of research has been conducted in close cooperation with the USAAVNC and its effort to revise its training standards to reflect increased emphasis on crew-level performance.

Subsequent to the initial testing of the training and evaluation system, the USAAVNC formed a Working Group to incorporate the results of the aircrew coordination research into revisions of the Aircrew Training Manuals (ATMs) for all Army aircraft. Beginning in February 1992, DRC worked closely with the USAAVNC Working Group to draft training and evaluation methods and materials for a crew coordination validation testbed effort. Drafts of the Field Exportable Training and Evaluation packages were tested and validated with the cooperation of the 101st Aviation Brigade (Air Assault) at Fort Campbell, KY from 3 August - 2 September 1992. In December 1992, DRC provided USARIARDA and USAAVNC the final version of the Aircrew Coordination Exportable Training Package to implement the recently revised ATMs.

During the validation testbed, crews from the 5th and 9th Air Assault Battalions (UH-60) at Fort Campbell, KY were battle rostered, that is, formed into pairs, and completed four missions in the flight simulator with their battle rostered crewmember. In demonstrating and validating the new field exportable program for training and evaluating crew coordination skills, testbed

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results showed that the crews performed their missions more effectively and safely after the training than before the training. Validation testbed results are discussed in a separate report delivered to USARIARDA (Simon & Grubb, 1993). Repeated flights with the same crewmember surfaced the issue of the interactive effect of battle rostering and crew coordination training on crew performance. The USAAVNC selected the 229th Attack Helicopter Battalion (AH-64) Fort Rucker, AL to provide battle rostered crews to receive crew coordination training as the first phase to address this research issue.

Objective

To determine the effects of crew coordination training and evaluation methods on AH-64 attack helicopter battalion crew performance.

Method

Personnel

Five standardization instructor pilots (SIPs) from the USAAVNC's Directorate of Evaluation and Standardization (DES) received an abbreviated version of the Aircrew Coordination Exportable Training Package, called the Evaluator Course, to prepare them to evaluate the performance of unit instructors operating as aircrews during instructor level crew coordination training. Focusing on only the evaluation aspect of the course design was marginally effective. Although the DES SIPs were capable of evaluating crew coordination skills, their lack of exposure to the complete training syllabus threatened to undermine the credibility of the crew coordination program.

note that this was done at USAAVNC's request

Four instructor pilots (IPs) and four unit trainers (UTs) received training to present the Aircrew Coordination Student Course and to conduct the pre- and post-training evaluations and training missions.

Fifteen battle rostered aircrews consisting of a pilot and a copilot gunner participated in the training. Seven of the 15 crews included a unit IP or UT crew coordination instructor. Additionally, unit observation and utility helicopter crewmembers, both rated and nonrated, attended the classroom instruction. Three observation helicopter instructors and four observation helicopter aircrews participated in testing crew coordination evaluation procedures in the actual aircraft (Zeller, 1993).

Materials

Both the training and evaluation components of the Aircrew Coordination Exportable Training Package, December 1992 were implemented as published.

The training package is designed for three audiences: trainers, instructors, and aircrews. USAAVNC certified crew coordination trainers teach unit instructors, who then train unit aircrews, both rated and nonrated crewmembers. Training for the unit instructors consisted of 26 hours of classroom instruction, four 5-hour missions in the AH-64 combat mission simulator (CMS), and five hours of practice evaluating crew performance. Classroom instruction for unit instructors covered methods of instruction, the Aircrew Coordination Student Course, and scenario development and evaluation procedures. Training for unit aircrews consisted of 18 classroom hours and four 5-hour tactical missions in the CMS. Simulator missions included premission planning and rehearsal, simulator flight, crew level after-action review, and an instructor debriefing.

The AH-64 CMS is a fixed-base simulation system designed for training in the use of AH-64 Apache helicopters. The CMS simulates the Apache helicopter and its related systems to the same level of performance as found in the operational systems. The CMS consists of two separate compartments for the pilot and copilot gunner, each having a six-degree-of-freedom hydraulic motion system. Each compartment includes a crewmember station, pilot or copilot gunner, in the forward portion and instructor/operator and observer stations in the rear portion. Each compartment is equipped with a visual system that simulates natural helicopter environment surroundings. The CMS provides normal and emergency procedural mission training and weapons delivery. Additional capabilities include navigation, instrument flight operation, day, dusk, and night visual flight operations, ordnance delivery and aircraft survivability systems of the attack helicopter. In addition, The CMS can be used to simulate tactical threat systems.

Each simulator mission was recorded using four video cameras multiplexed onto one video picture. All intercom and radio communications and aural warnings were recorded onto the videotape. One camera was placed in each simulator compartment and aimed to provide a high-over-the-shoulder view of each crewmember. Two cameras were placed in the project control room and aimed at monitors to capture each crewmember's visual field of view and symbology overlay.

Evaluation procedures are an integral part of the training package for unit instructors. Measures similar to those previously used for the utility helicopter validation testbed

were developed to test data collection techniques using the AH-64 CMS. The primary question asked through the use of the evaluation measures was whether the aircrews showed improvement between the pre- and post-training evaluations. The measures and the results of their use in the attack helicopter training are described in this report. Following is a list of measures used in the training. Measures that are part of the training package are italicized.

1. Attitude. The "Army Aviation Crewmember Questionnaire".

2. *Behavior*. Basic Qualities associated with crew coordination captured through the use of the Aircrew Coordination Training Grade Slip.

3. *Behavior and Performance*. A grade slip based on AH-64 ATM tasks revised to incorporate aircrew coordination considerations.

4. *Crew Mission Performance*. Measures of crew performance made during tactical scenario execution.

5. Participant Exit Interviews. A form for debriefing participants at the conclusion of the training.

Four attack helicopter tactical scenarios were developed for the crew-level evaluations to assess changes in crew mission performance and training missions to apply classroom instruction. The baseline evaluation was conducted prior to the crew coordination training. The second evaluation was administered after the training. Crew exposure to the evaluation scenarios was counterbalanced, that is, crews given evaluation scenario one for the pretraining mission were given scenario two for the post-training mission and vice versa. The objectives and tasks incorporated into the two evaluation scenarios were made to present two equally difficult missions to the aircrews. Two training scenarios followed the classroom instruction and preceded the post-training evaluation. Figure 1 shows how training scenarios one and two provided step increases in difficulty leading to the post-training evaluation mission. This progression in mission difficulty supported the Army's "crawl-walk-run" training philosophy.

Difficulty

```
|  Pretraining        ◄----------------►   Post-training
|  Evaluation              Counterbalance     Evaluation
|
|
|                          Training
|                            Two
|
|
|
|               Training
|                 One                              .
|
|_____  Sequence
```
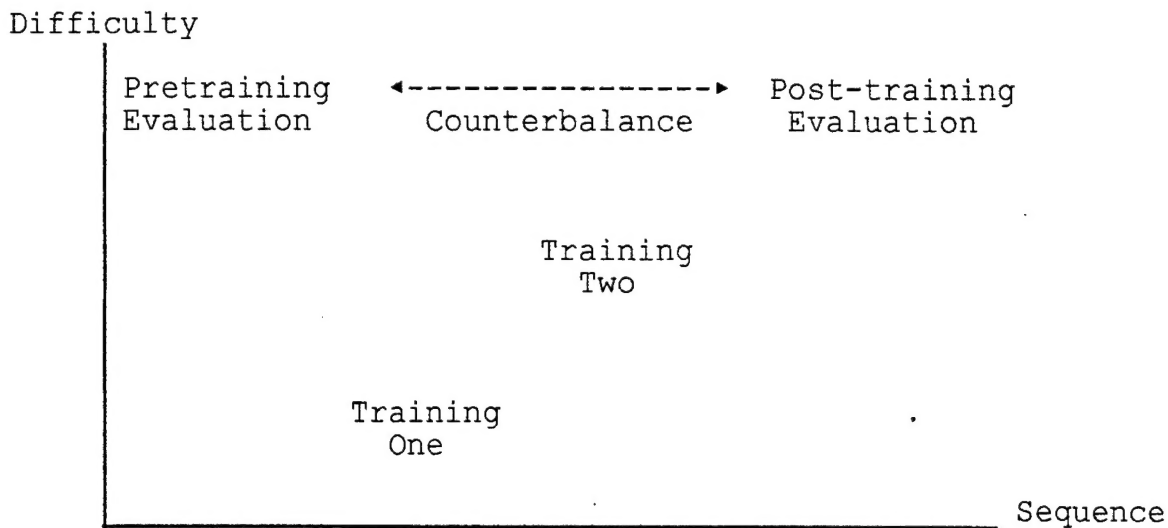
Figure 1. Evaluation and training scenarios

Procedures

The training schedule is presented in Table 1. The first step in the training was for project staff to instruct DES SIPs to assist in evaluating the unit instructor evaluation and training missions. Project staff and DES then instructed and evaluated the participating IPs and UTs.

After receiving instruction, the IPs rated the 15 aircrews during a full (premission, flight, post-mission) simulator mission. This was the pretraining evaluation designed as the baseline against which performance improvements would be

measured. The 15 attack helicopter crews were divided into two sections for the classroom instruction. Utility helicopter crews and battalion staff members were added to one of the academic sections. A third academic section was formed for observation helicopter aircrews. Instructor teams consisting of unit IPs and UTs, were formed to team-teach the classroom instruction. The instructor teams also instructed the aircrews during the two training missions. Subsequent to the training, the post-training evaluation was given to each of the 15 attack helicopter aircrews.

When the evaluation missions were completed, training participants were asked to participate in an exit interview to critique the training.

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Table 1

Training Schedule

Activity	Date
Evaluator Training	12 - 14 May 93
• DES SIPs	
Instructor Training	1 - 11 Jun 93
• IPs and UTs	
Pretraining Evaluation Mission	14 - 16 Jun 93
• AH-64 crews	
Aircrew Training[1]	18 - 30 Jun 93
• AH-64 crews	
• OH-58 crews	
• UH-60 crews	
Post-training Evaluation Mission	1 - 7 Jul 93
• AH-64 crews	
Participant Exit Interviews[1]	8 - 9 Jul 93

[1] Includes battalion staff personnel

Results of the Training

This section summarizes the results from the pre- and post-training evaluations in terms of the measures described above.

Attitudes

The Army Aviation Crewmember Questionnaire includes 46 statements for which aviators are asked to rate the extent of their agreement or disagreement on a seven-point scale. Also included in the questionnaire is a section used to collect background data from the respondents. The current version of the Army Aviation Crewmember Questionnaire is presented in Appendix A.

The Army Aviation Crewmember Questionnaire is used to assess three primary attitudes associated with crew coordination.

1.   Communication and Coordination. An orientation toward interpersonal awareness, communication, and crew coordination.

2.   Shared Leadership. An attitude toward the appropriateness of sharing responsibility for leadership.

3.   Recognition of Stressor Effects. An attitude accepting that human performance is affected by external events and allowance must be made for changed performance.

The questionnaire was administered twice: once at the end of the pretraining evaluation mission and a second time at the end of the post-training evaluation mission. Scale scores were computed for the 3 attitude areas and a total score was computed for all 46 items. The twenty-three negatively worded items were recoded so that a 7 represented the most desirable answer, that is, 1=7, 2=6, 3=5, 5=3, 6=2, and 7=1. Average item scores for each scale were computed for the pre- and post-training missions. Table 2 shows the means of the pre- and post-training results and whether the difference between the two is statistically significant.

Table 2

Comparison of Mean Item Scores for Pre- and Post-training Administrations of the Army Aviation Crewmember Questionnaire

IP/UT's and Aviators (n=30)

Attitude scale	Pre-training	Post-training
Communication and Coordination	5.86	5.81
Shared Leadership	5.55	5.45
Recognition of Stressor Effects	4.66	4.67
Whole Questionnaire	5.53	5.47

Crewmembers participating in the training generally had a favorable attitude toward crew coordination in both the pre- and post-training evaluations. There were no statistically significant changes between the pre- and post-training results.

Behaviors

Crew behaviors are the principal means to teach and evaluate crew coordination in the Aircrew Coordination Exportable Training Package. Based on previous research, the USAAVNC defined crew coordination behaviors as 13 Basic Qualities. Each Basic Quality was designed to be rated by an IP-evaluator on a seven-point scale. The seven-point scale was anchored at the 1, 4, and 7 levels with specific behavioral descriptions of performance at those levels. IP-evaluators were instructed to interpolate

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ratings of 2, 3, 5, and 6 from the descriptions given at the 1, 4, and 7 levels as being somewhat better or worse than the anchored description. The numbers associated with the Basic Quality ratings were 1 = Very Poor, 2 = Poor, 3 = Marginal, 4 = Acceptable, 5 = Good, 6 = Very Good, and 7 = Superior. IP-evaluators provided the Basic Quality ratings on a grade slip designed for the training package. The Basic Quality definitions, anchor descriptions, and rating guidelines are provided in Appendix B.

Table 3 shows a comparison of Basic Quality item means between pre- and post-training evaluations for the eight crews without an IP or UT crewmember. There was improvement in every Basic Quality. Despite the small sample size, a statistically significant improvement was reached on 6 of the 13 Basic Qualities. On average, crews moved from a rating of "marginal" to "acceptable" within the timeframe of the training. Understanding that crew coordination requires practice, the goal of the initial training was to achieve a rating of "acceptable." Continuation training is required to move beyond the "acceptable" level of performance.

Behavior and Performance

ATM tasks contained in the ATM for the AH-64, TC 1-214 (Department of the Army, 1992, May) were used as a measure of behavior and performance during the training. All ATM tasks include both a crew coordination and a technical flight skill component. IP-evaluators rated crews on various ATM tasks but were required to rate crews on 25 selected tasks for each evaluation mission. The 25 tasks were selected for the following reasons:

1. They provided a common means for comparing crew pre- and post-training evaluation missions.

2. They are crew coordination intensive.

3. The 25 tasks were represented in the evaluation scenarios.

Two forms were used to record ATM task and Basic Quality performance: (a) DA Form 7121-R, Mar 92, entitled Battle-Rostered Crew Evaluation/Training Grade Slip and (b) the Aircrew Coordination Training Grade Slip based on DA Form 5882-R, Mar 92, entitled Maneuver/Procedure Grade Slip for AH-64 Aviators. For purposes of this report, these two forms are collectively referred to as the grade slip. Blank grade slips are provided in Appendix C.

Table 3

Basic Quality Comparisons between Pre- and Post-training
Evaluation Missions

Crews (n=8)

	Basic Quality	Pre-training		Post-training
1	Establish and maintain flight team leadership and crew climate	4.50		4.88
2	Premission planning and rehearsal	3.88		4.25
3	Selection of appropriate decision making techniques	3.50		3.63
4	Prioritize actions and distribute workload	3.38	**	4.13
5	Management of unexpected events	3.13	**	4.13
6	Statements and directives clear, timely, relevant, complete, and verified	3.25	**	4.88
7	Maintenance of mission situational awareness	3.13		3.88
8	Decisions and actions communicated and acknowledged	3.63		4.25
9	Supporting information and actions sought from crew	3.63	*	4.38
10	Crewmember actions mutually cross monitored	2.88_	**	4.00
11	Supporting information and actions offered by crew	3.50	*	4.38
12	Advocacy and assertion practiced	3.38		4.13
13	Crew-level after-action reviews accomplished	4.38		4.63
	All 13 Basic Quality Ratings	3.54	**	4.27

$*p \leq .05$ $**p \leq .01$[2]

[2]For this table and subsequent tables, significant change
(*) indicates a 95% probability that the results from the sample
are what would occur if the entire population had completed the
training. Highly significant change (**) equates to a 99% prob-
ability that the sample results reflect the entire population.

IP-evaluators graded ATM task performance on a four-point scale: S+, S, S-, and U. When a crew received a grade of S- or U due to crew coordination, IP-evaluators noted two Basic Qualities contributing to the task grade. Basic Quality ratings are recorded on page 2 of the Aircrew Coordination Training Grade Slip. IP-evaluators provided written comments and an overall grade for the flight on the Battle-Rostered Crew Evaluation/Training Grade Slip. The ATM task grades were translated for computer analysis so that S+ = 3, S = 2, S- = 1, and U = 0.

Table 4 shows a comparison between each of the 25 ATM task grades and the overall grade for the flight on the pre- and post-training evaluation missions. The table also shows a comparison between the average task grade for all 25 ATM tasks. It is noteworthy that performance for 24 of the 25 ATM tasks improved. Performance for one ATM task remained the same. Although a sample this small is unlikely to render statistically significant results, nine of the comparisons represent significant improvement from pre- to post-training scores.

The average score for the 25 ATM tasks improved significantly. Before the training, the crews were able to obtain an S/S- level of performance. After the training, crews attained an S level of performance. As a group, task-level performance improved by one-half a grade subsequent to the training. The overall grade for the flight, a grade composed of technical flying skill, crew coordination, and mission effectiveness, also improved by one-half a grade: on the pretraining evaluation, the average grade was slightly above S-, whereas after the training, the overall grade was nearly S.

Table 4

Aviators (n=8) GROUPED T-Tests

ATM Task Grade[3] Comparisons between Pre- and Post-training
Evaluations

	AH-64 ATM Task	Valid n	Pre-training		Valid n	Post-training
1000	Crew Mission Briefing	8	1.75	*	8	2.25
1004	DA Form 5701-R (PC)	8	1.88		8	2.13
1007	Engine-start, run-up, hover, and before take-off checks	8	1.75		7	2.00
1016	Hover Power Check	8	1.00	**	8	2.00
1023	Fuel Management Procedures	8	1.13	*	7	2.14
1026	Doppler Navigation	8	1.75		7	2.14
91033	Terrain Flight Mission Planning	7	1.86		8	2.13
1034	Terrain Flight Takeoff	8	1.25	**	8	2.13
1035	Terrain Flight	8	1.25	*	8	1.88
1038	Terrain Flight Approach	7	1.29	*	7	2.14
1064	Terrain Flight Navigation	8	1.75		8	2.00
1068	Emergency Procedures	8	1.50	*	8	2.25
1076	Radio Navigation	3	1.33		5	1.80
1081	Nonprecision Approach	3	0.33	*	5	1.40
1083	IMC Procedures/VHIRP	3	1.33		5	1.60
1090	Masking & Unmasking	5	1.40		8	1.63
1095	A/C Survivability Equipment	8	1.63		8	2.13
1119	Firing Position Ops	8	1.75		8	1.75
1140	Engage Tgt w/Hellfire	8	1.38		8	1.63
1141	Engage Tgt w/Arcs	1	1.00	--	3	2.00
1142	Engage Tgt w/AWS	1	0.00	--	2	2.00
2008	Evasive Maneuvers	8	1.25		7	1.86
2043	FARP Procedures	7	1.86		6	2.00
2050	Select Appropriate Weapon System	8	1.75		8	1.88
2052	ID Targets w/TADS	8	1.88		8	2.13
	Average Score for the 25 Tasks	8	1.50	**	8	1.97
	Overall Grade for Flight	8	1.25		8	1.75

*p ≤ .05   **p ≤ .01 -- could not be perform test:no variance or too few cases

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[3] (U=0, S-=1, S=2, S+=3)

When an ATM task was graded S- or U and the grade involved crew coordination, IP-evaluators noted two Basic Qualities contributing to the grade. Table 5 shows which ATM tasks were problems and which Basic Qualities contributed to less than satisfactory task performance. Looking down the columns in Table 5, there were improvements in the following Basic Qualities:

BQ3 Application of appropriate decision making techniques
BQ4 Prioritize actions and distribute workload
BQ5 Management of unexpected events
BQ6 Statement and directives clear, timely, relevant, complete, and verified
BQ7 Maintenance of mission situational awareness
BQ8 Decisions and actions communicated and acknowledged
BQ9 Supporting information and actions sought from crew
BQ10 Crewmember actions mutually cross-monitored
BQ11 Supporting information and actions offered by crew
BQ12 Advocacy and assertion practiced

The following Basic Qualities continued to contribute to less than satisfactory task performance or improved only slightly. These Basic Qualities should receive increased emphasis from crew coordination trainers and instructors:

BQ2 Premission planning and rehearsal
BQ3 Application of appropriate decision making techniques
BQ7 Maintenance of mission situational awareness
BQ10 Crewmember actions mutually cross-monitored

Looking across the rows in Table 5, one can see that crews continue to struggle with certain ATM tasks even after crew coordination training. Although Table 4, the ATM Task Grades, also shows which ATM tasks were problematic, Table 5 presents more precise information because it is linked to the Basic Qualities. The following is a list of the ATM tasks that continue to cause problems after the training, that is, those tasks with four or more Basic Quality negative notations:

1081 Perform nonprecision approach
1083 Perform inadvertent IMC procedures/VHIRP
1090 Perform masking and unmasking
1119 Perform firing position operations
1140 Engage target with Hellfire

Collectively, these five tasks accounted for 47 (35%) of the negative notations. This type of information should alert the unit to the ATM tasks that need to be emphasized in the commander's crew coordination training program.

Table 5

Less Than Satisfactory ATM Task Performance and Inhibiting Basic Qualities for Pre- and Post-training Evaluation* (n=8)

Task	BQ1	BQ2	BQ3	BQ4	BQ5	BQ6	BQ7	BQ8	BQ9	BQ10	BQ11	BQ12	BQ13	Totals
1004		1|1	0|1			1|0								2|2
1007						1|0				1|0				2|0
1095							1|0	1|0		1|0		1|0		4|0
1119						1|0	2|2			1|1	0|1			4|4
1140			0|3			1|0	3|1			1|0		1|0		6|4
1141			1|0				1|0							2|0
1142							1|0			1|0				2|0
1000		1|0	1|0		1|0									3|0
1016		0|1	2|0	1|0		1|0	2|0		1|0	3|1				10|2
1023				2|0			1|0			2|0				5|0
1026					1|0		2|0				1|0			4|0
1034						2|0	1|0		1|0	3|0				7|0
1035			2|0			1|0	2|1			3|1		1|0		9|2
1038				1|0			1|0		1|0	2|0	1|0			6|0
1064							1|1							1|1
1068				2|0						1|0	2|0			5|0
1083			1|1	1|0			1|2			0|1				3|4
1090			0|1			1|0	2|2			1|2	1|0			5|5
1076					1|0		1|1							2|1
1081		0|1				0|1	2|2			3|1	1|1			6|6
1033			1|0		1|0				1|0					3|0
2008			1|0		3|0		1|1					1|0		6|1
2043										1|0				1|0
2052										1|0				1|0
2050			0|1				1|0			1|0				2|1
Totals	0|0	2|3	9|7	7|0	7|0	9|1	26|13	1|0	4|0	26|7	6|2	4|0	0|0	101|33

*Within each column, numbers to the left are pre-training and numbers to the right are post-training.

BQ1=Crew climate	BQ2=Plan rehearse	BQ3=Decision techniques BQ4=Work load BQ5=Unexpected events
BQ6=Positive comm	BQ7=Situation awareness	BQ8=Comm/acknowledged BQ9=Info sought BQ10=Cross-monitor
BQ11=Info offered	BQ12=Advoc/assert	BQ13=After Action Reviews

Crew Mission Performance

Aircrews were given attack helicopter tactical missions to perform in the AH-64 combat mission simulator (CMS). Data was collected from the two evaluation missions (pre- and post-training) to determine whether mission performance was enhanced as a result of the training. The evaluation scenarios included a mix of the mission segments and activities shown in Figure 2.

Mission Segments

Premission planning
Forward assembly area to
rearm and refuel
Rearm and refuel to holding area
Holding area to battle position
Battle position to battle position
Battle position to rearm and
refuel/recovery airfield

Activities

Navigation
Threat avoidance and evasion
Minor/major malfunction
Occupy battle position
Acquire, identify, and engage targets
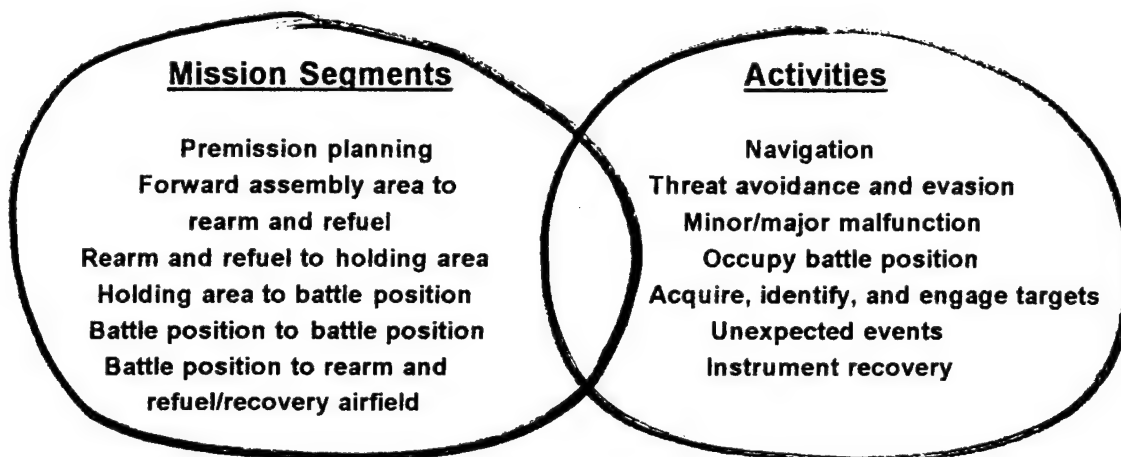Unexpected events
Instrument recovery

Figure 2. Evaluation scenario outlines

Mission performance measures are not required in the Aircrew Coordination Exportable Training Package. The purpose of including mission performance measures in the attack helicopter battalion training was to test measures and data collection procedures for possible use in the next phase of the project, that is, comparing performance of battle rostered and mixed aircrews. Project staff measured mission performance using a variety of data collection techniques: video recordings, live observation data log, simulator printouts, and evaluator worksheets. Mission performance data was analyzed in the following categories: navigation, weapons employment, threat, unexpected events, and instrument approach.

Mission Performance - Navigation. This performance measure evaluates the crew's ability to remain within altitude and course limitations as well as avoid inadvertent obstacle strikes and collisions with the ground.

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Overall, performance improved between the pre- and post-training evaluation missions. There was a 60% reduction in altitude deviations (8 to 3), a 50% reduction in course deviations (4 to 2), and a 40% reduction in obstacle/ground strikes (10 to 6). Three of the 8 crews evaluated had no altitude deviations while 5 crews had from 1 to 5 deviations per mission. Similarly, 3 crews had no course deviations whereas the other 5 crews had 1 deviation. One crew completed both evaluation missions without either altitude or course errors.

Mission Performance - Weapons Employment. This performance measure evaluates the crew's ability to properly identify, acquire, and accurately engage targets.

The 8 crews engaged 27% more targets (32 versus 44), shot 23% more missiles (41 versus 53), and scored 29% more hits and kills (29 versus 41) with the same number of misses (12) on the post-training mission. Most crews engaged targets only with missiles. Four crews fired rockets and one crew fired the gun during the 16 missions. Only one crew engaged targets with all three weapon systems. No rocket engagements hit or killed a target. The crew that engaged targets with the gun expended 100 rounds to realize 4 hits and 1 kill.

Mission Performance - Threat. This performance measure involves the crew's ability to avoid and successfully evade threat radar-controlled weapon systems. It also describes detrimental outcomes resulting from threat detection; that is, the crew becomes misoriented, the aircraft is hit, or the aircraft crashes. Threat systems used for both evaluation scenarios included: ZSU-23-4, SA6, SA8, and Straight Flush radars as well as T80 and T72 tanks.

All 8 crews were detected by threat systems during both the pre- and post-training evaluation missions. The average number of warnings for both missions was 6 with a range of 1 to 20 warnings per mission. The average number of warnings decreased from 9 to 4 between the pre- and post-training evaluations. More than 57% of the crews had fewer threat encounters on their post-training evaluation mission. There were 9 detrimental outcomes with over half of them occurring during the pretraining mission.

There were technical difficulties in collecting threat mission performance data. To support this measure in the CMS, a capability designed to record when the aircraft has line of sight with a target was used. When the aircraft was within range of

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the threat system's radar, the same line of sight criteria was used to record threat detection. However, the CMS has no capability to determine or record the threat radar operating mode; that is, search, track, or engage. Also, the number of threat radar warnings and the audio alert from the aircraft radar warning receiver confound recording the length of each warning. Additional research and development is needed to improve the precision of measuring threat related crew mission performance in the CMS.

Mission Performance - Unexpected Events. This performance measure evaluates the crew's ability to work in concert while coping with emergencies, malfunctions, and inadvertent entry into instrument meteorological conditions (IMC). This measure occurred only in one of the evaluation scenarios.

Crews experienced two emergencies in evaluation scenario number one. During the pre-training evaluation, 60% of the crews (3 of 5) managed the emergencies satisfactorily while 100% of the crews (3 of 3) satisfactorily performed the emergency procedures in the post-training evaluation. The two unsatisfactory crews during the pretraining evaluation experienced a hard landing and crash respectively.

During evaluation scenario number two, crews experienced a 500 pound loss of fuel after departing the first battle position enroute to the next battle position. Three crews experienced this malfunction during their pretraining evaluation. Five crews experienced the malfunction during the post-training evaluation. Data was not recorded for one of the post-training evaluation crews. Only 42% of the crews (3 of 7) detected the fuel leak; 1 during the pretraining evaluation and 2 during the post-training evaluation.

Also in evaluation scenario number two, crews experienced deteriorating weather conditions on the flight back to the forward arming and refueling point which resulted in a loss of visual reference while terrain flying. As with the fuel leak, three crews experienced inadvertent entry into instrument meteorological conditions (IMC) during their pretraining evaluation. Five crews experienced IMC during their post-training evaluation. Only one crew's performance of recovery procedures was less than acceptable resulting in a crash during a pretraining evaluation. There were no crews who performed poorly during the post-training evaluation.

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Mission Performance - Instrument Approach. This performance measure evaluated the crew's ability to plan and execute a non-precision instrument recovery procedure after inadvertently entering IMC.

Coupled with the IMC unexpected event, this measure occurred only during evaluation scenario number two. Three dimensions of this measure were observed for each crew: planning the approach, timing the inbound leg of the approach, and the outcome of the approach. Pre- and post-training evaluation results are combined because of imprecise data collection procedures and less than satisfactory crew performance of the ATM task overall. Less than 50% of the crews (3 of 7) recorded during pre- and post-training evaluations adequately planned the approach. Only 1 crew of the 6 crews recorded during pre- and post-training evaluations properly timed the approach. Two of the three pretraining evaluations resulted in unsuccessful approaches, that is, missed approach and airfield not in sight.

Participant Exit Interviews

Instructors were interviewed after the last day of the training. Prior to the exit interview, instructors and crewmembers were given the interview questions to make notes on the items they wanted to discuss. Instructors and many of the crewmembers wrote answers to the interview questions and gave them to the project staff. Instructors were interviewed as a group during a two-hour session. The project staff recorded the group's responses and discussions. After all the interview data were collected, that is, participant written responses and project staff notes, the responses were entered into computer files, edited for readability, and compiled to eliminate duplicate responses. The results of the analysis are presented in Appendix D. Following is a summary of the suggested improvements from the instructor exit interviews:

1. Instructors should receive the Student Course block of instruction with their battle-rostered crewmember. Participating as a crewmember after receiving the Instructor Course tends to degrade the battle-rostered crewmember's training.

2. The methods of instruction block should be the last subject in the Instructor Course. Emphasis should be on instructional techniques and main points of instruction for each syllabus hour.

3.   Instructors should be required to "teach back" the material to the trainers as a check on the new instructor's teaching ability.

4.   When the course is exported, USAAVNC should consider monitoring the new instructor's first training class for content accuracy and presentation technique.

5.   Video tapes of the flight are essential for effective training and evaluation.

Conclusions and Recommendations

The crew coordination training of AH-64 attack helicopter battalion crews at Fort Rucker, AL was very effective. The data collected show that the crew coordination training and evaluation system positively affects behavior, enhances mission performance, and increases the margin of safety. The positive results reported in this paper are comparable to the results achieved by UH-60 crews in the 1992 Crew Coordination Exportable Training Package validation testbed. For example, the ATM task average grade for both types of crews improved one-half grade between pre- and post-training evaluations. Basic Qualities 7, Maintenance of Mission Situational Awareness, and 10, Crewmember Actions Mutually Cross-monitored, made the largest contribution to decreasing less-than-satisfactory ATM task performance.

Crew performance improvements in the navigation measure, especially obstacle strikes and ground collisions, and the weapons employment measure confirmed the effectiveness of both the training itself and the trial measures and data collection procedures. All five mission performance measures provided meaningful data. As described in the report, there were a number weaknesses in the trial measures that require improvement prior to the data collection phase of the interaction of battle-rostering and crew coordination research project. Also, there were suggested improvements to the course of instruction that warrant consideration. Following is list of recommendations for both the course of instruction and evaluation measures and data collection techniques.

1.   Avoid attempts to abbreviate the Aircrew Coordination Exportable Training Package to meet specific project or target audience needs. For example, the abbreviated Evaluator's Course to train a group of IP-evaluators marginally prepared participants to evaluate crew performance while failing to

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provide sufficient understanding of the fundamentals of crew coordination. Efforts such as this could potentially jeopardize the entire crew coordination program, because in this situation the recipients were a highly influential group of DES SIP aviators.

2.   Develop options for implementing the Aircrew Coordination Exportable Training Package that allow trainers and instructors to change the sequence and format of selected blocks of instruction. For example, develop materials to support teaching the methods of instruction block last, include participant teach-back of materials, exchange an evaluation mission of an operational crew for reviewing video segments as a means to practice evaluation techniques, and include an administrative support plan checklist for new instructors to coordinate required resources to teach other instructors and/or unit aircrews.

3.   Discontinue use of the Army Aviation Crewmember Questionnaire as a research tool. Little useful information will be gained through its use.

4.   Refine mission performance measure descriptions and criteria to exploit CMS capabilities. For example, develop efficiency ratios for missile engagements.

5.   Research CMS capabilities to provide more precise threat measurement data. For example, identify methods to collect type of threat warning and duration measures.

6.   Analyze data collection sources and workload requirements to prepare a data collection plan that provides a cross-check among sources without burdening any one collection source or requiring extensive review of mission video tapes. For example, determine specific collection tasks for IP-evaluator using evaluator worksheets, CMS console operator using preprogrammed report formats, and live observation data collectors using data logger software.

7.   Schedule and control scenarios and crews to provide valid comparisons of crew performance across scenarios and conditions. For example, ensure that crew exposure to scenarios with malfunctions and IMC can be compared within groups without having to repeat every condition in each scenario.

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Appendix A

Army Aviation Crewmember Questionnaire

Army Aviation Crewmember Questionnaire

Instructions

The US Army Aviation Center (USAAVNC) and the US Army Research Institute (ARI) are researching the area of crew coordination in Army Aviation. The goal of this research is to improve performance and increase the margin of safety on an Army-wide basis. Previous research in the area of crew coordination has contributed to substantial gains in both performance and safety.

Because Army Aviation is unique, much of the information discovered by other services and the commercial world is not directly applicable to the Army Aviation environment. Consequently, the USAAVNC-ARI research program is designed to meet the specific needs of Army aviation. As a result of this approach, the following actions are now ongoing or planned: Mission simulations are being developed to stress aircrew-type tasks, enhanced aircrew coordination training is being deployed, the US Army Safety Center is incorporating crew factors into the accident investigation process, new Aircrew Training Manuals have been written, the annual proficiency and readiness test program is being revised, and revisions to readiness reporting are being planned.

This Army Aviation Crewmember Questionnaire has been developed as part of the USAAVNC-ARI research program to obtain your opinion about crew operations. As an Army aviator, your participation is essential to the program's success. Your opinions are important and will be used to guide the next phase of the research program.

The questionnaire should take approximately 20 minutes to complete. The first page of the questionnaire asks you for background information -- please try to be accurate. The next three pages contain 46 statements for which there are no "right" or "wrong" answers. We are simply asking for your honest opinion to each statement. Please consider each statement carefully.

THANK YOU FOR YOUR PARTICIPATION.

IMPORTANT

The information you provide in this questionnaire is confidential and will be used for research purposes only. Your answers will neither be attributed to you personally nor become a part of any personnel or aviation record kept on you.

Army Aviation Crewmember Questionnaire

I. Background Information
(Please complete the following information regarding your personal experiences and current status.)

1. Aviation Experience:
   (including visual flight simulator hours)

	Lifetime Flying Experience		Experience over last 6 months	
	All Conditions	NV Devices (e.g., NVG)	All Conditions	NV Devices (e.g., NVG)
a. Primary acft hrs.	_____	_____	_____	_____
b. R/W hrs.	_____	_____	_____	_____
c. Fixed Wing hrs.	_____	_____	_____	_____

2. Primary Aircraft _____ *(Fill in aircraft designation)*

3. Current Rank _____

4. Current Unit (Co/Bn/Rgt) _____

5. Time in Current Unit (months) _____

6. Current Aviator Readiness Level (RL)   1   2   3   FAC   *(circle one)*

7. Current Crew Readiness Level (CRL)   1   2   *(circle one)*

8. Current primary duty assignment in unit *(circle one)*:

   PC*   PI   CP   CPG   CE/FE   AO/AFSO/TO   OR*

   Note: PC includes IP, SP, IE, UT, ME, MP duty positions; OR includes gunner and flight medic.

9. Have you previously had Aircrew Coordination Training?   Yes or No   *(If yes, answer below.)*

   Course Title(s)_____   Approximate Date(s)_____

10. Are you battle rostered with another crewmember?   Y or N   *(circle one)*.

    If yes, for how long? _____months.

    Approximately how many hours have you flown in the last:

    a.   30 days   _____battle rostered hours   _____total hours

    b.   60 days   _____battle rostered hours   _____total hours

    c.   90 days   _____battle rostered hours   _____total hours

    d.   180 days   _____battle rostered hours   _____total hours

11. Cross-indexing Code (*Note*: Because the results of this questionnaire will be correlated with other measures, a social security number is required.)

Social Security #: _____Today's Date_____

(day/mo/yr)

II. Opinion Survey

(Please circle the number on the agree-disagree dimension that best reflects your personal attitude toward each statement. There are no "right" or "wrong" answers. We are simply asking for your honest opinions.)

		Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
1.	Crewmembers should feel obligated to mention their own psychological stress or physical problems to other crewmembers before or during a mission.	1	2	3	4	5	6	7
2.	Crewmembers should monitor each other for signs of stress or fatigue and should discuss the situation with the affected crewmember(s).	1	2	3	4	5	6	7
3.	Good communication and crew coordination are as important as technical proficiency for the safety of the flight.	1	2	3	4	5	6	7
4.	Crewmembers should be aware of and sensitive to the personal problems of other crewmembers.	1	2	3	4	5	6	7
5.	The pilot flying the aircraft should verbalize plans for procedures or maneuvers and should be sure that the information is understood and acknowledged by affected crewmembers.	1	2	3	4	5	6	7
6.	Even when fatigued, I perform effectively during most critical flight maneuvers.	1	2	3	4	5	6	7
7.	Pilots-in-command should encourage pilots and crew chiefs to question procedures and flight profile deviations during normal flight operations and in emergencies.	1	2	3	4	5	6	7
8.	There are no circumstances where the pilot should take the aircraft controls without being directed to do so by the pilot-in-command.	1	2	3	4	5	6	7
9.	A debriefing and after action review of procedures and decisions after each mission are important for developing and maintaining effective crew coordination.	1	2	3	4	5	6	7
10.	Crew coordination is more important under high stress conditions than it is under low stress conditions.	1	2	3	4	5	6	7
11.	Effective crew coordination requires crewmembers to take into account the personalities of other crewmembers.	1	2	3	4	5	6	7
12.	The pilot-in-command's responsibilities include coordinating inflight crew chief activities.	1	2	3	4	5	6	7
13.	Most crewmembers are able to leave personal problems behind when flying a mission.	1	2	3	4	5	6	7

	Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
14. My decision making ability is as good in emergencies as it is in routine mission situations.	1	2	3	4	5	6	7
15. The pilot-in-command is solely responsible for leadership of the crew team.	1	2	3	4	5	6	7
16. Pilots should consider crew chief questions and suggestions.	1	2	3	4	5	6	7
17. When joining a unit, a new crewmember should not offer suggestions or opinions unless asked.	1	2	3	4	5	6	7
18. Because crew chiefs have no pilot training, they should limit their attention to their formally defined crew chief duties.	1	2	3	4	5	6	7
19. Pilots-in-command who accept and implement suggestions from the crew lessen their stature and reduce their authority.	1	2	3	4	5	6	7
20. Crewmembers should monitor the pilot-in-command's performance for possible mistakes and errors.	1	2	3	4	5	6	7
21. The best way to correct an error is to alert the error maker so that he can correct the problem.	1	2	3	4	5	6	7
22. Crewmembers' errors and mistakes during the mission, including the pilot-in-command's mistakes, should be a significant part of post flight crew discussions.	1	2	3	4	5	6	7
23. The pilot-in-command should seek advice from crewmembers when updating mission plans.	1	2	3	4	5	6	7
24. The pilot-in-command should use his crew to help him maintain situation awareness.	1	2	3	4	5	6	7
25. The pilot-in-command is solely responsible for maintaining awareness of crew capabilities.	1	2	3	4	5	6	7
26. Only when the pilot-in-command is overloaded should he pass workload to other crewmembers.	1	2	3	4	5	6	7
27. Crewmembers should be aware of other crewmembers' workload.	1	2	3	4	5	6	7
28. If a crewmember is having difficulties executing his responsibilities, other crewmembers should provide assistance.	1	2	3	4	5	6	7
29. Highly competent pilots do not experience task overload.	1	2	3	4	5	6	7
30. A crewmember should offer task help to another crewmember only if he is sure the crewmember needs it.	1	2	3	4	5	6	7

		Strongly Disagree	Disagree	Slightly Disagree	Neutral	Slightly Agree	Agree	Strongly Agree
31.	The pilot-in-command should not get involved with the execution of responsibilities assigned to other crewmembers.	1	2	3	4	5	6	7
32.	Crewmember task overload usually occurs because the crewmember is not very competent.	1	2	3	4	5	6	7
33.	Pilots-in-command should employ the same style of leadership in all situations and with all crewmembers.	1	2	3	4	5	6	7
34.	Pilot-in-command instructions to other crewmembers should be general and non-specific so that each individual can practice self-management and can develop individual skills.	1	2	3	4	5	6	7
35.	A relaxed attitude is essential for maintaining a cooperative and harmonious cockpit.	1	2	3	4	5	6	7
36.	Reprimands are more effective than discussions in eliminating a crewmember's poor flying habit.	1	2	3	4	5	6	7
37.	Nonrated crewmembers should be actively involved in planning the mission.	1	2	3	4	5	6	7
38.	Understanding the commander's concept is of minor importance to mission execution.	1	2	3	4	5	6	7
39.	Each crewmember should watch for situations in which external events limit others' performance.	1	2	3	4	5	6	7
40.	Thinking through difficult segments, events, and tasks is primarily the pilot-in-command's responsibility.	1	2	3	4	5	6	7
41.	My knowledge of unit SOP and aircraft emergency procedures makes rehearsing familiar missions unnecessary.	1	2	3	4	5	6	7
42.	An essential element of premission planning is discussing crew responsibilities and required actions for abnormal events.	1	2	3	4	5	6	7
43.	Recent events in my personal life have little to do with my performance as a crewmember.	1	2	3	4	5	6	7
44.	Crewmembers should be able to anticipate requirements as the mission progresses.	1	2	3	4	5	6	7
45.	My individual performance is as good in degraded systems conditions as it is in a "full up" aircraft.	1	2	3	4	5	6	7
46.	External circumstances require crewmembers to provide situational leadership for short periods of time.	1	2	3	4	5	6	7

Appendix B

<u>Aircrew Coordination Rating Guidelines and Basic Qualities</u>

Note: The Aircrew Coordination Evaluation (ACE) Checklist,
developed for use in the Field Exportable Evaluation Package, is
presented here as an index to the crew coordination Basic
Qualities

Rating Scale

The following numeric rating scale is used to assess the level of behavior that crews exhibit for each basic quality shown on the Aircrew Coordination Evaluation (ACE) Checklist (see Figure B-1) and at the bottom of the Aircrew Coordination Training Grade Slip. Each basic quality is rated using a seven-point scale with values ranging from 1 (very poor) to 7 (superior):

Very Poor	Poor	Marginal	Accept- able	Good	Very Good	Superior
1	2	3	4	5	6	7

Rating Guidelines

Written descriptions of the types of behaviors and levels of performance are shown for rating values 1, 4, and 7. These descriptions serve as behavioral "anchors" and are designed to assist evaluators in determining how well a crew performs on each basic quality in relation to a well-defined set of behaviors. Evaluators should use the "anchors" as the standard for making ratings--avoid comparing one crew's performance with that of another crew's; rate a crew's performance in relation to the "anchors." To ensure reliable ratings, continue to refer to the anchors when making rating responses until *completely* confident and understand *fully* how to rate each basic quality.

In completing a basic quality rating, evaluators should decide whether the behaviors observed fall into the low end of the basic quality range (values 1 or 2), the middle of the range (values 3, 4, or 5), or the high end of the range (values 6 or 7). Once the general range of response is selected, use the anchors to help select the final rating value. For example, if a crew did an adequate job of pre-mission planning and rehearsal, the rating would come from the middle of the range (3, 4, or 5). After determining this, review the behavioral description (anchor) associated with value 4 to determine if crew performance resembled this description (4 value), was somewhat less than this description (3 value), or was a little better than this description (5 value). Use the end-point anchors similarly to help determine ratings that fall near the ends of the scale.

Army aviation crews that have little or no training in aircrew coordination techniques will score most frequently in the lower half of the scale. Most other crews, however, will fall into the middle area of the scale. Keep in mind that although Army aviators have well developed basic flying skills, as a group, their aircrew coordination skills will be much like the rest of the population. A few crews will have strong coordination and communication skills, a few will have weak skills, and a significant number will have moderate skills.

AIRCREW COORDINATION EVALUATION (ACE) CHECKLIST

For use of this form, see Aircrew Coordination Exportable Evaluation Package for Army Aviation.

PC_____   Date _____

PI _____

NCM _____

_____

NO	CREW COORDINATION BASIC QUALITIES	RATING
1	Establish and maintain flight team leadership and crew climate (Crew Climate)	
2	Premission planning and rehearsal accomplished (Plan Rehearse)	
3	Application of appropriate decision making techniques (Decision Tech)	
4	Prioritize actions and distribute workload (Workload)	
5	Management of unexpected events (Unexp Events)	
6	Statements and directives clear, timely, relevant, complete, and verified (Info Xfer)	
7	Maintenance of mission situational awareness (Sit Aware)	
8	Decisions and actions communicated and acknowledged (Comm/Ack)	
9	Supporting information and actions sought from crew (Info Sought)	
10	Crewmember actions mutually cross-monitored (Cross Monitor)	
11	Supporting information and actions offered by crew (Info Offered)	
12	Advocacy and assertion practiced (Advoc/Assert)	
13	Crew-level after-action reviews accomplished (AAR)	

Evaluator's Signature:

Notes:
Consult the behavioral anchored rating guidance. Enter a summary rating (1, 2 ... 7) in the rating block for each Basic Quality. Refer to the rating scale below.

RATING SCALE						
Very Poor 1	Poor 2	Marginal 3	Acceptable 4	Good 5	Very Good 6	Superior 7

AIRCREW COORDINATION EVALUATION (ACE) CHECKLIST

Figure B-1. Behavioral anchored ratings.

===

BASIC QUALITY 1. *Establish and maintain flight team leadership and crew climate (Crew Climate)*

===

Explanation:

This rating assesses the quality of relationships among the crew and the overall climate of the flight deck. Aircrews are teams with a designated leader and clear lines of authority and responsibility. The pilot-in-command sets the tone of the crew and maintains the working environment. Effective leaders use their authority but do not operate without the participation of other crewmembers. When crewmembers disagree on a course of action, rate the crew's effectiveness in resolving the disagreement. Note: Traditional leadership centralizes leadership in the leader with followers fully dependent on the leader. Functional leadership assigns leadership and followership roles as the situation evolves. Flight team leadership recognizes the impact of leadership style on the working environment. Regardless of leadership style, the pilot-in-command retains final decision and direction authority.

Superior Rating (7)

The crewmembers have very good interpersonal relationships. They respect each others' skills and appear to enjoy being with each other. The climate is very open; crewmembers freely talk and ask questions. Crewmembers encourage the individual with the most information about the situation-at-hand to participate. There is a genuine concern for good working relationships. No degrading comments or negative voice tones are used in interactions. Disagreements are perceived as a normal part of crew interactions, and the crew directly confronts the issues over which the disagreement began. Arguments or disagreements focus on behaviors or solutions rather than on personalities. Each crewmember carefully listens to others' comments. Senior crewmembers accept challenges from junior crewmembers. Alternative solutions are explored. The solution produced is a "win-win" situation in which all crewmembers' opinions are considered. The crewmembers have no hard feelings at the conclusion of the incident.

Acceptable Rating (4)

The crewmembers have sound interpersonal relationships and seem to respect each others' skills. The climate is an open one, and crewmembers are free to talk and ask mission questions. Regardless of rank or duty position, the individual with the most information about the situation-at-hand is allowed to participate. When disagreements arise, the crew directly

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confronts the issues over which the disagreements began. The
primary focus is on behaviors or solutions, and no personal
attacks are made in the heat of discussion. The solution is
generally seen as reasonable. Problem resolution ends on a
positive note with very little hostility or grumbling among
crewmembers. Mutual respect is clearly intact.

Very Poor Rating (1)

Crew interactions are often awkward and uncomfortable. The
crewmembers do not appear to like or respect each other.
Crewmembers may be curt and impolite to each other. Requirements
for assistance are made as commands rather than as requests for
support. When disagreements arise, the crew fails to directly
confront the issues. Personal attacks may arise. Senior
crewmembers are resistant to recommendations from junior
crewmembers. Crewmembers do not explore the range of possible
solutions. They may shout and argue without finding a solution.
One or more crewmembers may retreat and say nothing at all. A
"win-lose" situation develops in which one crewmember is shown to
be right and the other to be wrong. The crewmembers show little
respect to one another except for deferring to formal rank.

BASIC QUALITY 2. Pre-mission planning and rehearsal accomplished (Plan Rehearsal)

Explanation:

This rating assesses the pre-mission planning and rehearsal
activities that the crew performs upon receiving a mission order.
Time available determines whether pre-mission planning and
rehearsal is completed prior to the flight or in the cockpit.
During this period crews--

•Clarify the mission order and the commander's intent
•Assign actions, duties, and mission responsibilities
•Collect information (intelligence, communications,
weather, flight planning) and develop the plan
•Conduct crew briefing to review and discuss the plan
•Identify potential problem areas and courses of action
•Assess risks
•Visualize and rehearse the mission

Although the pilot-in-command is responsible for leading this
activity, evaluate the extent and manner in which the entire crew
participates. Also, consider the time constraints on the crew. If
there is insufficient time to conduct comprehensive planning and
rehearsal, evaluate the crew on their planning and rehearsal of

the most critical segments of the mission. That is, either prior to the flight or in the cockpit, did the crew address the most important issues given the time available? Note: The relationship among crew members should be observed during this period but the crew climate evaluation should be made on rating basic quality 1, Flight Team Leadership and Crew Climate.

Examples:

•UH-60 Task 2078 and AH-64 Task 1033, Perform terrain flight mission planning: The crew will analyze the mission in terms of METT-T and plan the flight as directed by the PC. The crew will rehearse important aspects of the mission.

•UH-60 and AH-64 Task 1000, Conduct crew mission briefing: Aircrew collectively visualizes and rehearses expected and unexpected events from takeoff to tie-down; all factors of the flight; and actions, duties, and responsibilities of each crewmember.

•AH-64 and UH-60 Task 1068, Perform or describe emergency procedures: PC will include in the crew briefing the general approach to all emergency procedures requiring immediate action.

Superior Rating (7)

The entire crew discusses a detailed description of the mission and the commander's intent. All actions, duties, and mission responsibilities are partitioned and clearly assigned to specific individuals. The crew acquires new and updated information and uses it to develop the mission plan from the aircrew mission briefing. Questions and discussion about the mission, commander's intent, and specific responsibilities are encouraged. Potential problems are noted and discussed in detail. Courses of action and individual responsibilities are established in the event that potential problems actually occur. All crewmembers speak out and acknowledge an understanding of the operational risks in the mission plan. The pilot-in-command leads the crew in mentally rehearsing the entire mission by visualizing and talking the crew through potential problems and contingencies. Crewmembers acknowledge understanding their assigned responsibilities and cues for actions. The tone of the interaction is friendly and professional.

Acceptable Rating (4)

A brief description of the mission is provided to the entire crew. The mission responsibilities are partitioned and assigned to specific individuals. Actions are taken to update current information that adds to the aircrew mission briefing and helps develop the mission plan. One or more crewmembers make comments during the course of developing the mission plan. Potential mission problems are only briefly discussed. There is adequate

preparation for contingencies. Crewmembers briefly discuss the
operational risks in the mission plan. Mental rehearsal is
initiated by the pilot-in-command or another crewmember who talks
through potential problems or contingencies for one or more
mission segments. Some discussion takes place to clarify
responsibilities in the event of unexpected problems or
contingencies. The tone of the interaction is generally friendly
and businesslike.

Very Poor Rating (1)

The pilot-in-command briefs the mission with little or no
attendant explanation. There is little or no discussion of
responsibilities or their assignments to specific crewmembers.
The pilot-in-command develops the mission plan from the aircrew
mission briefing and current information. Crewmembers tend not to
ask questions about the mission. If asked, questions tend to be
cut off, only briefly addressed, or ignored by the other crew-
members. Little or no mention is given to potential problems or
complications. No crewmember says anything about operational
risks or weaknesses in the plan. Any suggestion to talk through a
potential problem or mentally rehearse responsibilities is
rejected as unnecessary. The tone of the interaction is
business-like, abrupt, and impersonal.

BASIC QUALITY 3. Application of appropriate deci-making techniques (Decision Tech)

Explanation:

This rating evaluates the manner and quality of the crew's
problem solving and decision making performance throughout the
planning and execution of the mission. Factors to consider in
making this evaluation include (1) information available to the
crewmembers, (2) time urgency of the decision, (3) objectivity
reflected in the decision process, and (4) level of involvement
and information exchange among the crewmembers. The time
critical demands of tactical flying require many decisions to be
made on an automatic, pattern-recognition basis with only a
minimum level of information exchange. However, when adequate
time and information are available, crewmembers are expected to
engage in a more deliberate and interactive style of decision
making. The evaluation of crew decision making performance
should ask the following questions: (1) Did the crew use all of
the available information? (2) Was the level of information
exchange among crewmembers appropriate for the time available?
(3) Was the type of decision process (deliberate versus
automatic) appropriate for the time available?

Examples:

•UH-60 and AH-64 Task 2044, Perform actions on contact: Crew will discuss options for developing the situation, then choose a course of action that supports the intent of the unit commander's directives.

•AH-64 and UH-60 Task 2083, Negotiate wire obstacles: Crew will discuss the characteristics of the wires . . . to determine the method of crossing.

Superior Rating (7)

Crew decision making consistently reflects proper attention to available information throughout mission planning and execution. The level of crew participation and deliberate analysis of options is appropriate for the decision time available. Resulting decisions are timely and appropriate given the time urgency and level of information available in each situation. Crewmembers do not exhibit any of the known hazardous thought patterns (e.g., anti-authority, impulsivity, machoism, invulnerability, resignation, get-home-itis, overconfidence in other aviator) and appear motivated to seek the most mission effective and safe decision in each situation. The crew decides and implements a course of action before the situation jeopardizes crew performance or mission accomplishment.

Acceptable Rating (4)

Crew decisions occasionally reflect inadequate sharing or use of available information. On limited occasions, crewmembers dwell excessively on some issues while neglecting more time urgent requirements. Most decisions are timely, but crew performance begins to show signs of self-induced stress. Most decisions are appropriate for the situation, with the crew occasionally overlooking one or more factors or options. Crewmembers occasionally fail to recognize or exploit opportunities for additional planning or rehearsal, substituting instead *ad hoc* strategies or plans. Crewmembers do not exhibit any of the known hazardous thought patterns. The situation may worsen, without seriously degrading mission accomplishment, before the crew decides and implements a course of action.

Very Poor Rating (1)

Crew performance (both pre-flight and in-flight) reflects an inflexible style of decision making (either deliberate or automatic) regardless of time urgency. Crewmembers may engage in excessive deliberation, overlook the relative time urgency of competing decision requirements, or fall victim to inappropriate mind sets. As a result, decisions frequently lack timeliness, ignore important factors, or appear out of context. Information

exchange and crewmember interaction is minimal, with the result
that critical input is ignored or not sought. Crewmembers may
display one or more of the known hazardous thought patterns
(e.g., machoism, anti-authority, get-home-itis). The crew may be
unable to decide or implement a course of action before a
situation becomes critical.

BASIC QUALITY 4. Prioritize actions and distribute workload (Workload)

Explanation:

This is a rating of the effectiveness of time and work
management. Rate the extent to which the crew as a team avoids
being distracted from essential activities, distributes workload,
and avoids individual crewmember overload.

Examples:

•AH-64 and UH-60 Task 1080, Perform procedures for two-way radio
failure: P* will remain focused outside the aircraft or inside
the cockpit on the instruments, as appropriate. He will not
participate in troubleshooting the malfunction.

•UH-60 Task 2079 and AH-64 Task 1064, Perform terrain flight
navigation: P will focus his attention primarily inside the
cockpit; however, as workload permits, he will assist in clearing
the aircraft and provide adequate warning of traffic and
obstacles.

Superior Rating (7)

Virtually all distractions are avoided. Each crewmember
understands precisely what information is relevant to the mission
and what information is simply a distraction. If a crewmember
becomes mildly distracted, other crewmembers remind him to focus
on the mission task. Non-critical duties are prioritized and
delayed until low workload periods or post-flight periods.
Crewmembers are aware of workload build ups on others and
readjust workload by assuming emerging, unassigned tasks
appropriate for their duty station. Overloads do not occur. The
crew's planning horizon is always "ahead of the aircraft."

Acceptable Rating (4)

Most distractions are avoided. The crew performs well in
deciding what information and activities are essential to the

mission. Most non-essential information is discarded or ignored.
Non-critical duties are prioritized and delayed until low
workload periods or post-flight periods. Crewmembers are aware
of individual crewmember workloads during each phase of the
mission. When an individual crewmember appears to be overloaded,
other crewmembers take on part of the workload. The crew is
always "in sync with the aircraft."

Very Poor Rating (1)

The crew is easily distracted. The crew is unable or unwilling
to decide what is important and relevant to the immediate
mission. There is little prioritizing of duties or actions.
Time and energy may be wasted on low priority tasks. Risks to
crew safety may occur as the crew focuses on minor tasks while
critical tasks requiring immediate attention go unattended,
(e.g., setting a radio frequency when attention should be focused
on clearing an obstacle.). Neither the overloaded party nor
other crewmembers takes voluntary actions to eliminate an
overload condition. The crew makes little or no effort to
redistribute task responsibilities as mission changes occur and
new tasks arise. Individual crewmembers experience workload
overloads. The crew's planning horizon is sometimes "behind the
aircraft."

BASIC QUALITY 5. Management of unexpected events (Unexp Events)

Explanation:

This rating evaluates the crew's performance under unusual
circumstances that may involve high levels of stress. This
judgement includes the integration of technical and managerial
aspects of contending with the situation. Note: Enter the
abnormal or emergency situation in the Aircrew Coordination
Training Grade Slip (some emergency procedure ATM tasks are
preprinted) and grade it the same as any task.

Examples:

•AH-64 and UH-60 Task 2008, Perform evasive maneuvers: The most
important consideration in an emergency is aircraft control--
first assess aircraft controllability, check systems indicators,
take evasive action.

•UH-60 Task 1068, Perform or describe emergency procedures: CE
will keep communications to a minimum to allow the P* or P to
attempt communications outside the aircraft.

Superior Rating (7)

The crew remains calm during the situation. Each crewmember seeks to understand the problem and provides the pilot-in-command with essential information. Each crewmember immediately takes on particular workload responsibilities based on prior discussions and rehearsal of potential problems and contingencies. The crew effectively communicates its actions and results to others and provides feedback to ensure complete coordination of efforts. Each crewmember handles his own responsibilities and seeks to support the crewmember with the greatest workload. The crew rapidly imposes the maximum amount of control possible over the situation given the available time and internal and external resources. A high level of situation awareness is maintained throughout the event.

Acceptable Rating (4)

The crew responds to the problem and the pilot-in-command's requests for information but does not overreact. The pilot-in-command's requests for information are met by feedback from the crew. The crew takes actions to reduce the pilot-in-command's work overload and provides information even if it is not specifically requested. The pilot and crew make good use of available resources. The crew is intense but not flustered by the situation. Adequate situation awareness is maintained throughout the event.

Very Poor Rating (1)

The crew becomes disorganized and flustered. The pilot-in-command's requests for information elicit inadequate responses. Crewmembers may focus on the wrong issues, thus delaying correct diagnosis of the problem. The crew focuses on only one solution to an event, does not consider other plausible alternatives, or chooses an inappropriate solution. Lack of coordinated actions adds to the confusion. The pilot and crewmembers make poor use of available resources to resolve the problem. Situation awareness appears to decay during the situation.

BASIC QUALITY 6. Statements and directives clear, timely, relevant, complete, and verified (Info Xfer)

Explanation:

Rate the completeness, timeliness, and quality of information transfer. Carefully consider the crew's feedback techniques to

verify information transfer. In particular, evaluate the quality
of instructions and statements associated with navigation
activities, obstacle clearing activities, and instrument
readouts.

Examples:

•AH-64 Task 1015, Perform ground taxi: The P will announce
"Blocking" to acknowledge the P*'s announcement "Braking".

•UH-60 Task 2079, Perform terrain flight navigation: The P* will
acknowledge commands issued by the P for heading and airspeed
changes.

Superior Rating (7)

Crewmembers communicate frequently. Both senders and receivers
use standard terminology for nearly all communications. Senders
almost always provide clear, concise information. Receivers
acknowledge nearly all messages in sufficient detail so that the
sender can verify that the receiver understands the message.
Receivers ask for clarification when they do not understand.
Senders pursue feedback when no response is forthcoming. Whenever
a workload shift or task responsibility transfer occurs, the
change is communicated and acknowledged by the crew. All
navigation, obstacle clearing, and "inside" or "outside" the
cockpit information is stated, acknowledged, and updated.

Acceptable Rating (4)

Crewmembers communicate about the mission as required. Standard
terminology is usually used. Receivers acknowledge most
messages. Receivers ask questions when they do not understand.
Senders usually pursue feedback when no response is forthcoming.
Crewmembers are appraised of changes to responsibilities during
the flight. "Inside" and "outside" the cockpit duties are
specified and communicated to others.

Very Poor Rating (1)

Crewmembers may fail to make statements regarding critical
information. Non-standard terminology is used or standard
terminology is used inappropriately. Sender messages may be
inappropriately delayed or irregular and may be confusing.
Receivers usually do not verbally acknowledge the receipt of
messages. Receivers do not ask questions. Senders do not pursue
feedback when no response is forthcoming. Changes in
responsibilities during the mission are often not communicated
and may result in confusion over who has a task responsibility.
Navigation instructions and obstacle location information may be
incomplete or confusing. At times, "inside" or "outside" the
cockpit responsibilities are not clearly communicated.

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BASIC QUALITY 7. *Maintenance of mission situation awareness (Sit Aware)*

Explanation:

This rating assesses the extent to which crewmembers keep each other informed on the status of the aircraft and mission accomplishment. This information reporting helps maintain a high level of situation awareness among the flight crew. Information reported includes:

•Aircraft position and orientation
•Equipment status
•Personnel status
•Environment and battlefield conditions
•Changes to mission objectives

Crew-wide situation awareness is an essential element of safe flying and effective crew performance.

Examples:

•UH-60 Task 2009, Perform multi-aircraft operations: P and CE will provide adequate warning to avoid traffic or obstacles.

•AH-64 Task 2008, Perform evasive maneuvers: When engaged by the enemy, crew will announce the nature and direction of the threat.

Superior Rating (7)

Crewmembers routinely provide each other with updates on the status of the elements of situation awareness and the status of the mission. Crewmembers anticipate the situation awareness needs of others and request needed information when it is not forthcoming. Crewmembers are aware of each others' mental and physical states and are not hesitant to alert others to personal problems that could undermine effective performance. Personnel status is voluntarily shared without fear of sanctions. All changes in the elements of situation awareness are verbalized and acknowledged. Crewmembers alert other crewmembers to the presence of obstacles.

Acceptable Rating (4)

Crewmembers usually provide updates on the status of most of the elements of situation awareness and the status of the mission. Changes to the situation awareness elements are verbalized. Obvious changes in personnel status are noted and acknowledged without fear of sanctions.

Very Poor Rating (1)

Crewmembers do not routinely provide updates on the status of the aircraft or the status of the mission. Generally, updates are provided only on request; they are not made voluntarily. Personnel problems such as fatigue or lack of attention are not mentioned.

BASIC QUALITY 8. Decisions and actions communicated and acknowledged (Comm/ Ack)

Explanation:

Rate the extent to which decisions and actions are actually made and announced to the crewmembers after input is solicited from them. Crewmembers should respond verbally or with the appropriate adjustment to their behaviors, actions, or control inputs to clearly indicate that they understand when a decision has been made and what it is. Failure to do so may confuse crews and lead to uncoordinated operation. Note: Due to time constraints in certain situations, there is often little or no time for crews to make inputs to a decision. In such cases, raters should focus on the extent to which decisions are acknowledged verbally or through coordinated, pre-planned action.

Examples:

•UH-60 Task 2086, Perform masking and unmasking: P* will announce his intent to unmask. The P and CE will acknowledge that they are prepared to execute the maneuver.

•AH-64 Task 1038, Perform terrain flight approach: P* will announce intention of a go-around . . . whether approach will terminate to a hover or to the ground. P will acknowledge use of manual stabilator or any intent to deviate from the approach.

Superior Rating (7)

The pilot-in-command states decisions and actions and, time permitting, explains the reasons and intent. Crewmembers acknowledge the decisions with a clear verbal response and ask questions to clarify any confusion. The pilot-in-command answers all questions in a positive, straight-forward manner. Crewmembers keep the pilot-in-command informed of the results of their activities and changing responsibilities--especially visual area of responsibility or task focus. The crew clearly acknowledges results of actions, or changes, and then states its intended adjustments based on the information provided. If crewmembers do not acknowledge or adjust, the pilot-in-command

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requests acknowledgement. Crewmembers are particularly attentive
to the communication of workload responsibilities. When assuming
control of the aircraft or making control inputs, notification is
always given and acknowledgement received.

Acceptable Rating (4)

The pilot-in-command states decisions and actions along with,
time permitting, a brief explanation of the reasons and informs
the crew of the adjustments they are expected to make. The crew
acknowledges its awareness of the decisions and directions.
Crewmembers may ask questions to clarify confusion. The pilot
answers questions clearly and quickly and the crew adjusts to the
new situation. When assuming control of the aircraft or making
control inputs, notification is given and acknowledged.

Very Poor Rating (1)

Decisions and actions of a crewmember are often not passed on to
the crew. The pilot-in-command takes unilateral action and does
not explain or inform the crew of his intended purpose. The crew
is often not aware that a decision has been made. The crew
infrequently asks questions for clarification. The
pilot-in-command may not acknowledge or respond to questions. The
crew may not know how to react to changed circumstances.
Crewmembers are often unsure what responsibilities have been
assigned to them. Crewmembers may take uncoordinated actions
without stating intentions or results. Two pilots may attempt to
simultaneously take control of the aircraft when flight control
authority is unclear.

BASIC QUALITY 9. Supporting information and actions sought from crew (Info Sought)

Explanation:

This is a rating of the extent to which crewmembers, usually the
pilot-in-command, seek support information and support actions
from the crew. Evaluate the degree to which crewmembers raise
questions during the flight regarding plans, revisions to plans,
actions to be taken, and the status of key mission information.
Note: The extent to which crewmembers maintain situational
awareness and contribute to decision making should be observed
here but evaluated on basic qualities 7 and 4 respectively.

Examples:

•UH-60 Task 1032, Perform slope operations: P* will request assistance in setting the brakes.

•AH-64 Task 2044, Perform actions on contact: The crew will discuss options for developing the situation.

Superior Rating (7)

During the flight, crewmembers raise questions on plans or changes to plans and actions. Virtually all of these inquiries surface information that contributes to the mission decision making process. When the pilot-in-command realizes that a decision must be made during the flight, for which there is no clear standardized answer, he immediately alerts the crew to the situation and seeks suggestions on possible solutions and important information to consider. The pilot-in-command is open to all suggestions. Crewmembers respond to these inquiries with sound, task-focused discussions and clear answers that are provided in a timely manner. Crewmembers' inquiries are never ignored. All crewmembers encourage such questioning. When the pilot-in-command asks for assistance with actions he clearly states what assistance is required. He provides quick, clear feedback if the crewmember response is not what he expects. He asks for assistance before becoming overloaded.

Acceptable Rating (4)

During the flight, crewmembers occasionally raise questions on plans or actions when they are unclear on decisions being made. Most of these inquiries provide information that is relevant to the mission decision making process. The pilot alerts the crew to the need for decision input. Crewmembers usually respond to these inquiries with brief but reasonable answers. Crewmembers' inquiries are encouraged by other crewmembers most of the time. The pilot-in-command listens to suggestions without interruption or criticism. He asks for clarification as necessary. He only asks for assistance when he becomes overloaded.

Very Poor Rating (1)

During the flight, crewmembers almost never raise questions about plans, actions, or changes to plans. The pilot-in-command makes mission decisions without seeking inputs from other crewmembers. The pilot-in-command does not alert the crew that a decision is required or is being made. Decision making and planning are done by one individual with little or no discussion--an observer will have difficulty noting this quality for "very poor" crews since it is hard to detect individual decision making. The few inquiries that are made are generally ignored or abruptly answered. Crewmembers may discourage others from asking questions by the tone of voice they use or by failing to respond.

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The pilot-in-command may not ask for crew assistance with tasks even when he is overloaded to the point of nearly failing to properly execute tasks.

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BASIC QUALITY 10. *Crewmember actions mutually cross monitored (Cross Monitor)*

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Explanation:

This rating captures the extent to which a crew uses cross monitoring as a mechanism to avoid errors and improve future performance. Crewmembers are able to catch each other's errors. Such redundancy is particularly important when crews are fatigued or overly focused on critical task elements, and thus more prone to make errors. Included in this rating is the crew's use of aircraft technical manual checklists to perform required procedure checks and procedures (i.e., engine-start, run-up, before-takeoff, before- and after-landing, shutdown checks; HIT and emergency procedures). Note: This quality does not imply that task responsibilities are not clearly defined. It asks the question "To what extent do crewmembers help an individual assigned primary responsibility for a task or action by reviewing the quality of that individual's task execution and alerting him to any mistake noted?"

Examples:

•AH-64 Task 1094, Identify major US or allied equipment and major threat equipment: P* or P will announce the type and direction of the equipment detected. The other crewmember will confirm the type and direction of the equipment.

•UH-60 task 1023, Perform fuel management procedures: PC will confirm the results of the fuel check.

Superior Rating (7)

Each crewmember is concerned that all tasks are properly executed and checks both his tasks and those of others. When mistakes are noted, the crewmember making the error is quickly informed in a concise manner without excessive formality. The mistake maker accepts this review and feedback as a normal part of crew operations.

Acceptable Rating (4)

Crewmembers often check each other's task performance for errors. Mistake makers are informed and make the needed corrections. Only

occasionally are mistake makers annoyed at being checked and corrected.

Very Poor Rating (1)

Crewmembers seldom, if ever, check each other's task execution. Crewmembers are insulted if they are corrected by another crewmember.

BASIC QUALITY 11. Supporting information and actions offered by crew (Info Offered)

Explanation:

This is a rating of the extent to which crewmembers anticipate and offer support information and support actions to the decision maker, usually the pilot-in-command, when it becomes apparent that a decision must be made or an action taken.

Examples:

•UH-60 Task 2016, Perform external load operations: All crewmembers will assist in clearing the aircraft and will provide adequate warning of obstacles, unusual drift, or altitude changes.

•UH-60 and AH-64 Task 1081, Perform nonprecision approach: P will call out the approach procedure to the P*.

Superior Rating (7)

The crew recognizes that a decision must be made and offers suggestions and information to the pilot-in-command. The crew checks for responses that indicate understanding. The information is repeated, as necessary, to ensure that the pilot-in-command understands the input. Pilot-in-command responses can be verbal or non-verbal actions. The crew seeks information and provides it to support decisions and actions. The crew frequently offers task execution support. The support offered always reflects the pilot-in-command's task needs. Crews are quick to offer support during particularly difficult tasks such as obstacle clearing.

Acceptable Rating (4)

The crew recognizes that a decision or action must be made and offers suggestions and information to the pilot-in-command. The crew sometimes offers task execution support. Crewmembers usually offer obstacle clearing support.

Very Poor Rating (1)

The crew does not offer suggestions and inputs to support decision making or actions. Moreover, it often appears that the crew does not even realize that a decision is being made. The crew generally does not offer its services to support task execution for other crewmembers. Crewmembers may fail to offer obstacle clearing support.

BASIC QUALITY 12.   Advocacy and assertion practiced (Advoc/Assert)

Explanation:

This rating evaluates the extent to which crewmembers advocate a course of action they consider best, even when it may differ with the one being followed or proposed. Note: Except under extreme emergency conditions where time is absolutely

critical, it is usually in the crew's best interest to hear the full range of viewpoints available.

Examples:

•UH-60 and AH-64 Task 2083, Negotiate wire obstacles: Crew will discuss the characteristics of the wires . . . to determine the method of crossing.

•AH-64 Task 2044, Perform actions on contact: Crew will discuss options for developing the situation.

Superior Rating (7)

Crewmembers state to the rest of the crew a course of action that they consider best. They clearly explain their reasons for believing this to be the best course. Other crewmembers listen to the argument before presenting any criticism or proposing alternate courses. Discussions focus on the strengths and weaknesses of the proposed course of action, not on the personality of the crewmember who proposed the action.

Crewmembers call the crew's attention to changes in the situation and provide information that is essential to the proper execution of another crewmember's task. Crewmembers pursue feedback to ensure that their views are heard and understood. Other crewmembers expect such open comments and view them as positive contributions to mission performance.

Acceptable Rating (4)

Crewmembers state their support for a course of action or suggest improvements to other proposed actions. Each crewmember makes an effort to explain his position and convince others to concur with him on the course of action to be taken. Other crewmembers may interrupt with their views and alternatives. Crewmembers usually speak out when they recognize a departure from the mission plan or standard procedures or when they have a piece of information that is important to another's task execution. Crewmembers seek assurances that presented information has been received. Other crewmembers view such comments as constructive and not as a challenge to authority.

Very Poor Rating (1)

The crew almost never suggests a course of action. Crewmembers attempting to propose a course of action may be cut-off before they can propose the action or explain the rationale for that action. Crewmembers proposing courses of action may receive personal attacks. The crew raises few, if any concerns. Crewmembers may even fail to intervene when risks such as obstacles or poor visibility arise.

BASIC QUALITY 13.   Crew-level after-action reviews accomplished (AAR)

Explanation:

This rating evaluates the extent to which the crew reviews and critiques its decisions and actions during or following a mission segment, during low workload periods, or during the post flight debrief. Evaluate the crew on their discussion of strengths and weaknesses (for example, what was done wrong, what might be done better, how improvements can be made, and what was done very well) in flight skills and aircrew coordination.

Superior Rating (7)

The entire crew reviews and critiques its decisions and actions throughout the mission, including the pre-mission planning and rehearsal process. Crewmembers review factors considered in making their decisions, identify additional options or factors,

including ways to "buy time," that should have been considered, and discuss different methods of weighing information in the decision process. All discussions focus on behaviors and information and carefully avoid any "finger-pointing" tones. The focus is clearly on education and understanding to improve individual and collective performance.

Acceptable Rating (4)

Senior crewmember(s) review and critique the crew's decisions and actions during problematic segments of the mission. They determine the major mistakes in the crew's actions or decisions and identify remedial actions or alternative options for future missions. Although the critiques are intended to educate the crew and to improve their performance during future missions, they may include some accountability for unsatisfactory performance.

Very Poor Rating (1)

The crew either fails to review and critique its mission performance or if a critique is performed, it is punitive or accusatory. That is, the critique is conducted primarily to assign blame for unsatisfactory performance. Little effort is made to identify lessons learned or to suggest constructive ways to improve future performance.

Appendix C

Grade Slips

MANEUVER/PROCEDURE GRADE SLIP FOR AH-64 AVIATORS

For use of this form, see Aircrew Coordination Exportable Training Package and TC 1-214

P _____   Date _____

CPG _____

Instructor or evaluator will sign in the first unused block of each area trained or evaluated

NO.	STAN EVAL/TRAINING TASKS	GR	NO.	STAN EVAL/TRAINING TASKS	GR
1	CREW MISSION BRIEFING		37	IHADSS OPERATIONS	
2	PLAN VFR FLIGHT		38	DATA ENTRY PROCEDURES (FS)	
3	DA FORM 5701-R (PPC)		39	ACFT POSITION UPDATE (FS)	
4	PREFLIGHT INSPECTION		40	TARGET STORE (FS)	
5	ENG START, RUN-UP, T/O CKS		41	FIRING POSITION OPS	
6	HOVER POWER CHECK		42	ENGAGE TGT WITH HELLFIRE	
7	NORMAL TAKEOFF		43	ENGAGE TGT WITH ARCS	
8	TRAFFIC PATTERN FLIGHT		44	ENGAGE TGT WITH AWS	
9	FUEL MANAGEMENT PROCEDURES		45	WPNS INITIALIZATION	
10	DOPPLER NAVIGATION (FS)		46	TARGET HANDOVER	
11	BEFORE LANDING CHECK		47	IHADSS TARGET TRACKING	
12	VMC APPROACH		48	ORAL EVALUATION	
13	CONFINED AREA OPERATIONS		49		
14	SLOPE OPERATIONS		50		
15	TERRAIN FLIGHT TAKEOFF		51		
16	TERRAIN FLIGHT		NO.	NIGHT/NVD/EVAL/TRAINING TASKS	GR
17	NOE DECELERATION		1	CREW MISSION BRIEFING	
18	TERRAIN FLIGHT APPROACH		2	NVS OPERATIONAL CHECKS	
19	STANDARD AUTOROTATION		3*+	GROUND TAXI	
20	SIM SINGLE ENG FAILURE ALT		4*	HOVER POWER CHECK	
21	SIM SINGLE ENG FAILURE OGE		5*+	HOVERING FLIGHT	
22	SINGLE-ENGINE LANDING		6*+	NORMAL TAKEOFF	
23	ECU LOCKOUT OPERATIONS		7	ROLLING TAKEOFF (BS)	
24	TERRAIN FLIGHT NAVIGATION		8+	TRAFFIC PATTERN FLIGHT	
25	EMERGENCY PROCEDURES		9*	FUEL MANAGEMENT PROCEDURES	
26	IIMC PROCEDURES/VHIRP		10*	PILOTAGE & DEAD RECKONING	
27	MASKING AND UNMASKING (BS)		11*	DOPPLER NAVIGATION	
28	MAJ US/ALLIED/THREAT EQUIP		12*+	VMC APPROACH	
29	ACFT SURVIV EQUIP (BS)		13*	CONFINED AREA OPERATIONS	
30	AFTER-LANDING TASKS		14*	SLOPE OPERATIONS	
31	MARK XII IFF SYSTEM		15*	TERRAIN FLIGHT TAKEOFF	
32	TADS OPERATIONAL CHKS (FS)		16*	TERRAIN FLIGHT	
33	TADS BORESIGHTING (FS)		17*	NOE DECELERATION	
34	TADS SENSOR OPERATIONS (FS)		18*	TERRAIN FLIGHT APPROACH	
35	IHADSS BORESIGHT		19*+	SIM SINGLE-ENG FAILURE ALT	
36	IHADSS VIDEO ADJUSTMENTS		20*+	SINGLE-ENGINE LANDING	

AIRCREW COORDINATION BASIC QUALITIES

1. CREW CLI-MATE	2. PLAN RE-HEARSE	3. DECI-SION TECH	4. WORK LOAD	5. UNEXP EVENTS	6. INFO XFER	7. SIT AWARE	8. COMM ACK	9. INFO SOUGHT	10. CROSS MON-ITOR	11. INFO OF-FERED	12. ADVOC/ ASSERT	13. AAR

AIRCREW COORDINATION TRAINING GRADE SLIP

MANEUVER/PROCEDURE GRADE SLIP FOR AH-64 AVIATORS

NO.	NIGHT/NVD EVAL/TRAINING TASKS	GR	NO.	TRNG/MISSION/ADDITIONAL TASKS	GR
21*	TERRAIN FLIGHT NAVIGATION		1	DD FORM 365-4	
22*	EMERGENCY PROCEDURES		2	SIM MAX PERF T/O (BS)	
23	UNUSUAL ATTITUDE RECOVERY		3	DECELERATION/ACCEL (BS)	
24*	IIMC PROCEDURES/VHIRP		4	ROLL-ON LANDING (BS)	
25	MASKING & UNMASKING (BS)		5	TERRAIN FLT MISSION PLAN	
26	TADS OPERATIONAL CKS (FS)		6	HIGH-SPEED FLIGHT	
27	TADS BORESIGHT (FS)		7	SIM SINGLE ENG FAILURE IGE	
28	TADS SENSOR OPERATIONS (FS)		8	STABILATOR MALF PROCEDURE	
29	IHADSS BORESIGHTING		9	INSTRUMENT TAKEOFF (BS)	
30	IHADSS VIDEO ADJUSTMENTS		10	TWO-WAY RADIO FAILURE	
31	IHADSS OPERATIONS		11	PINNACLE OR RIDGELINE OPS	
32*	NVG FAILURE (FS)		12	HIGH/LOW G FLIGHT	
33	ORAL EVALUATION	.	13	EVASIVE MANEUVERS (BS)	
34			14	MULTIAIRCRAFT OPERATIONS	
35			15	CALL FOR/ADJUST IND FIRE	
36			16	VIS SIGNAL TECHNIQUES (FS)	
37			17	LASER SPOT TRACKER OPS (FS)	
NO.	INST EVAL/TRAINING TASKS	GR	18	FARP PROCEDURES	
1	CREW MISSION BRIEFING		19	ACTIONS ON CONTACT	
2	IFR FLIGHT PLANNING		20	ID TARGETS WITH TADS (FS)	
3	ENG START, RUNUP, T/O CKS		21	SELECT APPROPRIATE WPN SYS	
4	FUEL MANAGEMENT		22	TGT TRACKING WITH TADS (FS)	
5	BEFORE-LANDING CHECK		23	OPERATE ONBD RECORDER (FS)	
6	SIM SINGLE-ENG FAILURE ALT		24	DIVING FLIGHT (BS)	
7	EMERGENCY PROCEDURES		25	TECHNIQUES OF MOVEMENT (BS)	
8	RADIO NAVIGATION		26	NEGOTIATE WIRE OBSTACLES	
9	HOLDING PROCEDURES		27	TACTICAL COMMO AND ECCM	
10	UNUSUAL ATTITUDE RECOVERY		28	TRANS TACTICAL REPORT (FS)	
11	RADIO COMMUNICATIONS PROC		29		
12	NONPRECISION APPROACH		30		
13	PRECISION APPROACH		31		
14	IIMC PROCEDURES/VHIRP				
15	AFTER-LANDING TASKS				
16	ORAL EVALUATION				
17					
18					

NOTES:
*   REQUIRED FOR NVG EVAL
+   REQUIRED FOR NIGHT EVAL
ENTER S+, S, S-, OR U IN GRADE BLOCK. IF GRADE IS S- OR U DUE TO AIRCREW COORDINATION INCLUDE BASIC QUALITY NUMBER(S)

AIRCREW COORDINATION BASIC QUALITIES

1. CREW CLI-MATE	2. PLAN RE-HEARSE	3. DECI-SION TECH	4. WORK LOAD	5. UNEXP EVENTS	6. INFO XFER	7. SIT AWARE	8. COMM ACK	9. INFO SOUGHT	10. CROSS MON-ITOR	11. INFO OF-FERED	12. ADVOC/ ASSERT	13. AAR
R A T E												

PAGE 2, AIRCREW COORDINATION TRAINING GRADE SLIP

BATTLE-ROSTERED CREW EVALUATION/TRAINING GRADE SLIP
For use of this form, see Aircraft ATM; the proponent agency is TRADOC

BATTLE-ROSTERED CREW EXAMINEES/ TRAINEES	NAME	RANK
	PC:	
	PI:	
	NONRATED CREW MEMBERS	
	DUTY SYMBOL NAME RANK	
	UNIT:	
EVALUATOR/ INSTRUCTOR	NAME	RANK
	UNIT:	

CREW DATA

TOTAL BATTLE-ROSTERED CREW HOURS	DATE DESIGNATED A BATTLE-ROSTERED CREW:

PURPOSE: EVALUATION/TRAINING

TIME TODAY:	CUMULATIVE TIME:

TYPE AIRCRAFT: _____

CREW TASK 1 _____ D/N/NVD	CREW TASK 6 _____ D/N/NVD
CREW TASK 2 _____ D/N/NVD	CREW TASK 7 _____ D/N/NVD
CREW TASK 3 _____ D/N/NVD	CREW TASK 8 _____ D/N/NVD
CREW TASK 4 _____ D/N/NVD	CREW TASK 9 _____ D/N/NVD
CREW TASK 5 _____ D/N/NVD	CREW TASK 10 _____ D/N/NVD

DAY	NIGHT	WX	SIMULATOR	NVG	NVS

EVALUATOR/INSTRUCTOR RECOMMENDATIONS

☐   (ISSUE) (VALIDATE) CREW QUALIFICATIONS

☐   (SUSPEND) (REVOKE) CREW QUALIFICATIONS

☐   REQUIRES ADDITIONAL (FLIGHT) (ACADEMIC) (SIMULATION DEVICE) TRAINING

☐   SEE BACK FOR COMMENTS

I HAVE DEBRIEFED THE EXAMINEES/TRAINEES AND INFORMED THEM OF THEIR STATUS.
    EVALUATOR'S/INSTRUCTOR'S SIGNATURE: _____

WE HAVE BEEN DEBRIEFED BY THE EVALUATOR/INSTRUCTOR AND UNDERSTAND OUR CURRENT STATUS.

    PC'S SIGNATURE: _____

    PI'S SIGNATURE: _____

    NONRATED CREW MEMBER'S SIGNATURES: _____

    _____

OVERALL GRADE FOR THIS FLIGHT IS: S   U   NA   DATE:_____

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COMMENTS

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Appendix D

Exit Interview

AH-64 Instructor-Evaluator Exit Interview

I.   Course of Instruction

1.   Was the number of students in the class about the right size for this training?

- Instructor course should be 10-12 students; no more than 14 students maximum.
- Same number of students for the student course. Eighteen in the student course was too many.

[Does mixing platform types in the same class affect training?]
- No problem, as long as the instructor remains aware of who is in the class and asks for relevant input.

2.   Has adequate time (or too little/too much time) been allocated for each segment of the course? In answering this question, consider both the Instructor Course and the Student course.

- Instructor Course Introduction was too long. Too much repetition of material.
- Need only a brief introduction of about 1-2 hours.
- Covering the MOI first is not a logical flow. Put the MOI at the end of the regular course for the IPs/UTs.
- Unit IPs don't need to go through the course twice. They should go through the course the first time with their battle-rostered crewmember.
- Need to allow the IPs/UTs to "teach back" the material to the trainers as a check on their ability to teach. This could be a block where different IPs take a specific section to teach.

3.   How many simulator sessions [AH] or flight periods [OH] are required in the Instructor Course? In the Student Course?

- Okay as is with four missions minimum in each course.

4.   What effect, if any, did crew coordination trained IPs and UTs operating with their battle-rostered crewmember have on the training?

- Tends to degrade the other crew member's training.
- IPs have a hard time not remembering scenario details and artificially reacting to them because they have seen them before.
- IPs tend to either under react or overreact degrading training for both crewmembers.

5. **Should a simulator session where IP/UT crews rate each other be used for practice evaluations in the Instructor Course or are the rating exercises using video segments adequate?**

- If people are willing to allow it, you could use the initial evaluation flights as a practice mission tape to evaluate.
- Another option is to develop a "reenacted" video taped mission with known crew coordination errors/events for discussion.
- Taped missions can be stopped to allow discussion, whereas you can't do this as easily in the cockpit.
- More people can watch a video.

6. **What effect [AH], if any, did the pre-training evaluation mission in the simulator have on the classroom instruction part of the Instructor Course and the Student Course?**

- It was a good basis to start from and enhanced thoughtful discussion in both classes.
- It makes it easier to tie all the segments together and understand what is expected.
- Instructors were able to refer back to these initial evaluation missions often in the academic instruction.

7. **Did you read the read-ahead package materials? If, yes, did the read-ahead packages reduce the amount of time spent on specific subjects? Did they enhance the flow of the course? Did you review the homework assignments at the beginning of each day's instruction?**

- Most of the IPs did not read the material, except for the two-page pretraining evaluation item. This material was given over a weekend that was their first weekend off in a month. There was not much motivation to spend the weekend reading this material.
- The length of the course leaves you bored, even though the material is good. Read-aheads add to boredom.
- Material should be retained and used as a continuation training topic on safety stand down days.
- The accident briefs were interesting and many crew members read them.
- Need more videos to support the case studies--they were interesting and the examples do not have to be specific to the platform that the student flys.
- Practice AARs often had discussions diverging off talking about emergency procedures rather than the crew coordination aspects of the incident.

8. **Did the Instructor Course adequately prepare you to teach the Student course?**

- Academics-wise, no. There was still confusion on the specific points to teach in each section. This needs better coverage in an MOI section that stresses certain points to teach (better covered at the end of the course).
- Some of the IPs had never had training on how to teach from the platform, how to ask questions, how to draw out discussion, etc. Need to add platform instruction techniques to the MOI section. CAE-Link course has a platform instruction technique section in its MOI course.
- A little time in the course to practice teaching the material would provide a "confidence builder" for the IPs. The time allotted in the course was adequate; but, they didn't know what to do with the time in terms of practicing.
- The initial cadre might want to consider a follow-up visit to check on the IPs' ability to teach. This wasn't a problem in the unit because they were fresh out of the course. If you wait a month, you may have more problems that require a refresher "teach back" event.
- Need someone who has taught the course before to monitor new instructors. This would be a big help.

9. **Are there any Instructor Course segments (for example, MOI, evaluation, scenario development) that should receive more or less emphasis?**

- See item 8 comments on MOI above.
- Need more videos to support academic instruction.

II. Scenarios

1. **Were the evaluation scenarios of about the correct level of difficulty?**
- Yes. The basic scenarios were a good starting point. The units were not using the simulator to this extent before.
- Use of standardized scenarios would help.
- Avoid making the scenarios so difficult that they take all of the crews' concentration away from learning the crew coordination techniques.

2. **Were the evaluation scenarios reasonably realistic?**

- Yes.
- Developing a script was helpful since unit instructors had never done that before for their unit scenarios.
- Need some variety--e.g., movement to contact scenario, deep attack.
- Use of the scout aircraft was a little overdone, as compared to what the unit really does--e.g., more use of the other gun aircraft rather than scout aircraft.

3

- Incorporate unit specific METL tasks where possible.

3. Was there enough pre-mission planning time for the crews?

- Yes, always.

4. Did the scenarios allow adequate demonstration and observation of the 13 crew coordination Basic Qualities?

- Yes, they were adequate.
- Some of the emergency malfunctions could be more complex, requiring more than one step to be taken by the crew.
- Simulator limitations restrict the complexity of the malfunctions. Need to look for malfunctions that require crew interaction--IMC was a good training situation.
- Some BQs were not used very often--e.g., some of the information transfer BQs were lumped together.

5. Did the crew-level AAR checklist adequately cover all aspects of the mission? Should any items be added or deleted?

- A lot of people used it, but didn't follow it verbatim-- tailor to specific mission.
- The list provides good reminders of what you should cover.
- Reviews were conducted mainly by mission segment.
- A copy should be posted in the after action room.

III. Evaluation

1. Were mission videotapes/audiotapes of pre-mission planning, flight, and crew-level after action review segments helpful to instruct and evaluate? If yes, how were they helpful?

- The flight video tapes were especially helpful to review crew and individual skills. The tapes of the premission brief and AAR were not used.
- Tapes were a good tool for answering questions and resolving disputes over mission events and crew behavior. Used simulator page printouts also.
- Found the tapes useful to critique the CPG's scan patterns.

2. Are audio recordings [OH] and evaluator observations of flight segments adequate to instruct and evaluate crew coordination skills?

- Video tapes are essential.

3. **During your instructor debriefing, did you review the whole videotape/audiotape or did you refer only to specific segments?**

- IPs didn't look at the entire tape, but found it useful to review segments containing critical events.
- It was difficult to find the exact tape segments to return to. Consider recording in EP mode to allow quicker "fast-forward" scanning of tape.

4. **What general comments did the aircrews make as they observed/listened to their tapes?**

- Crews often catch mistakes themselves by looking at the video tapes.
- Tapes allow you to step outside yourself and look at the mission objectively. Draws out what the crew was thinking at the time.
- Crews should be required to watch their pre- and post-training evaluation tapes in their entirety, even though this requires a lot of time.

5. **If video recording of flight segments is not possible, can objective and reliable crew coordination evaluations be conducted in the aircraft? For example, can evaluations be conducted from--**

   a. A non-flying station (back seat or jump seat) [OH]?

- Not applicable.

   b. A flying station as a crewmember [AH & OH]?

- Not really as good as you can evaluate as a third person in the simulator.
- Use only as a last resort.

   c. Another aircraft [OH]?

- It could be done, but only 50% effective due to lack of intracrew observations.
- Could use mission tapes.

6. **Were the behavioral anchors useful or not useful to you in achieving objective and reliable ratings of crew performance? How did you use the behavioral anchors?**

- They were very useful, particularly for new evaluators.
- Evaluations are still subjective.

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7. **Did the video segments [used in the Instructor Course evaluation workshop and practice evaluations] provide adequate opportunity for practicing your application of the rating scales?**

-   Yes. See section I, item 5.

8. **Were you reluctant to give crews task and mission grades below "satisfactory" or crew coordination ratings below "acceptable"? If yes, why?**

-   No. Behavioral anchors were useful in justifying bad grades.
-   Showing evidence on tape was useful in justifying bad grades.
-   Most of the time the crews knew when they made mistakes.
-   You don't want too many unsatisfactory ratings; otherwise, you kill motivation to improve.

9. **How often did you refer to the written descriptions in the behavioral anchors?**

-   Occasional reference at first, then not necessary.
-   Infrequent review of superior anchors as most of the time only the "acceptable" rating was discussed in class.

10. **Was the satisfactory plus (S+), satisfactory (S), and satisfactory minus (S-) grading system helpful?**

-   Yes. Very helpful.
-   The use of S(-) was good as a "wake up call" that could be used to motivate without killing the person's enthusiasm.
-   Could provide some S(+) marks to balance things out and let the crews know that the evaluation isn't all negative.

IV. General Observations

1. **What is your overall impression of the adequacy of the aircrew coordination *training* provided? Do you have any recommendations for improvement?**

-   Overall the course was great.
-   Academics could be shortened as mentioned before, for example, place the MOI segments at the end of the course.
-   Don't change the simulator training.
-   Produce more AH-64 related video segments.
-   Observed major improvement in some crews in terms of workload management and assertiveness.
-   Good crews improved some. New crews made great improvements. Even crews with many hours together improved as a crew.
-   All crews learned from the training.

2. **What is your overall impression of the adequacy of the** *evaluation training* **provided? Do you have any recommendations for improvement?**

   - Consider reenacting flight segments for video tape and use in class as practice evaluations.

3. **What is your overall impression of the adequacy of the** *aircrew coordination evaluations*? **Do you have any recommendations for improvement?**

   - They were fair and objective.
   - The number of BQs allowed a fair evaluation and good feedback.
   - Instructors need to consider the mission circumstances in making ratings to ATM standards.
   - Should use the same IP to conduct the pre-training evaluation and last evaluation flight, with another IP doing the training in between.

4. **Did anything presented in the classroom or hands-on instruction suggest actions that could potentially compromise flight safety? If yes, please provide specific examples.**

   - No. Unfortunately, the CMS does not allow you to exercise the 2-challenge rule because it can't transfer controls rapidly without IO intervention.

5. **Do you have any questions, concerns, or recommendations that you would like to ask or convey to the crew coordination project staff?**

   - Much of the course contains material that has been discussed before within the unit; however, the course effectively brings it all together and writes it down in one place.
   - The 2-challenge rule needs to be clearly defined and discussed in depth.